

out taking an image. Any suitable mechanism for obtaining color balance information for the reference object may be used.

**[0010]** When a photograph is taken in which the object appears, a color transform is computed based on the image of the object as it appears in the photograph and the stored information taken from photographing the object under a known illumination. The color transform is applied to every pixel in the image to produce a color correction for the entire image, applying to the entire image the correction needed to correct the apparent color of the reference object.

**[0011]** The location of the reference object in the image to be corrected may be determined automatically or the user may assist in locating the reference object—for example, the user may point to the object or may mark off a region in which the object is located. It will be recognized also that the reference object may be photographed under the known illumination at any time; such photographing need not be performed before the taking of the photograph that is to be corrected. Anytime the object and a known illumination source are available, the object can be photographed under the known illumination source and data captured to inform a color correction of an existing photograph in which the reference object appears.

**[0012]** Thus, FIG. 1 illustrates a reference information system **100** according to an embodiment of the present invention. The system **100** comprises a reference color information station **102**, which itself suitably comprises a camera **104**, a platform **106**, an illuminator **108**, and a reference processing unit **110**, which comprises at least one processor (DP) **112** and memory (MEM) **116**. The memory **116** may comprise high speed memory, long term storage, or any combination thereof, and may store data **118** and programs (PROGS) **120**. The reference processing unit **110** may also suitably comprise one or more wired or wireless interfaces such as the interfaces **122A** and **122B**, which may be used to control and receive information from elements such as the camera **104** and the illuminator **108**.

**[0013]** A reference object **124** may be placed on the platform **106**, and the object **124** may be illuminated by the illuminator **108**, either independently of, or under the control of, the reference processing unit **110**, depending on design and configuration choices. An image may be taken of the reference object **124** and provided to the reference processing unit **110** which may then extract and store color balance information. The image may be taken automatically under control of the processor **112**, or may be taken by a user or under other automatic control separate from control of the processor **112**. However the image is captured, it is at some point made accessible for color balance information extraction.

**[0014]** In addition, or as an alternative, color balance information for a reference object may simply be measured, without an actual image being taken. Thus, as an alternative or in addition to the camera **104**, a chroma sensor **125** may be used. The chroma sensor **125** measures characteristics of light being reflected from the reference object **124** as the object **124** is illuminated by the illuminator **108**, and determines color balance information for the reference object **124**. It will also be recognized that the chroma sensor **125** may include its own built in illuminator and also that the particular configuration of the station **102** is chosen for convenience of illustration but the practice of embodiments of the invention is not limited to fixed positioning for the camera **104**, reference object **124**,

and chroma sensor **125**, but these devices may be arranged in any desired manner and may communicate through wire or wirelessly.

**[0015]** Extracted color balance information may be stored in the memory **118**, and may also or as an alternative be transferred to an external data repository **126**, which may be accessible through a network such as the Internet **128**.

**[0016]** In one exemplary embodiment of the invention, the reference color information station **102** may be operated by or on behalf of an enterprise. The enterprise may package a photography product such as a camera, photography capable mobile telephone, or image editing software with a reference object that can be placed in a scene to be photographed. The object may be wearable and may be, for example, a hat or badge, or may be adapted to be held by a person in a photograph, or the object may be adapted to be placed in a scene. Such an object adapted to be held or placed in a scene may, for example, take the form of a toy or stuffed animal. A user can take a picture, insuring that the packaged reference object appears in the scene, and color balance information for the reference object being photographed can be built into the photography product or, in another embodiment, made accessible to a user of a product—for example, by connection through the Internet **128** with the repository **126**. As a further alternative, reference objects such as the reference object **124** might be sold together with access to color balance information, and such reference objects might take any of numerous different forms, such as clothing, decorative objects, ornaments, or toys. Such objects may be associated with identifiers that can be provided to a photography product, such as by storing the identifier in a camera or photography-enabled telephone, or embedding the identifier in a reference object, such as in the form of a bar code or radiofrequency identifier. When the identifier is read, the photography product can retrieve the proper color balance information from its own onboard memory or from the repository **126**.

**[0017]** The system **100** has been illustrated and discussed as a separate mechanism for obtaining reference image information in order to illustrate mechanisms that may be particularly convenient for casual users. The information obtained by a system such as the system **100** may be made available to a user with very little work or consideration from the user. It will be recognized, however, that embodiments of the present invention can be devised that give the user as much control as desired, allowing a user to select his or her own reference object or to identify an object appearing in a captured image and then to capture a reference image of that object, with information obtained from the reference image then being used to color correct the existing scene image.

**[0018]** Thus, FIG. 2 illustrates a photography and correction system **200** according to an embodiment of the present invention, comprising an image capture device, a correction image capture device, a correction and image processing station, and an interface for connection to a correction information repository such as the repository of **126** of FIG. 1. The system **200** thus comprises a mobile telephone **201** having photographic capabilities, comprising an image sensor **202**, processor **204**, memory **206** storing data **210** and programs **208**, transmitter **212**, receiver **214**, antenna **215**, and interface **216**. The mobile telephone **201** includes color balance information **218**, which may include color balance information that has already been locally stored, identifier information for reference objects, and retrieval information for stored color balance information associated with reference objects and their identifiers. For example, the telephone **201** may collect color balance information for reference objects from the